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Residential Fuelwood Consumption and Production in Michigan, 1992

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FOREWORD

This bulletin contains the results of a study of 1992 residential fuelwood consumption and production in Michigan. Consumption refers to the volume of fuelwood burned by Michigan's wood-burning households, regardless of the source of the fuelwood (roundwood, wood residues from primary or secondary manufacturing, scrap or waste wood products, etc.). Production refers **only** to the volume of roundwood harvested to supply Michigan's wood-burning households. Such detailed information is necessary for intelligent planning and decisionmaking in wood procurement, forest resource management, forest industry development, and forest research. This report **does not** include information about harvesting for industrial fuelwood. Such information is included in reports covering wood use by primary processing plants.

Special thanks are given to the Michigan households and commercial producers who supplied information for this study. Their cooperation is greatly appreciated.

We acknowledge with special thanks the Michigan Department of Natural Resources and its contractors for their diligence in phoning and obtaining answers from these households and commercial producers.

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Residential Fuelwood Consumption and Production in Michigan, 1992

Dennis M. May, Anthony K. Weatherspoon, and Ronald L. Hackett

Since fuelwood's heyday in the late 1800's, its use as a primary home heating and cooking fuel has declined dramatically as homeowners opted for the convenience and efficiency of fossil-based fuels. If not for the energy crisis of the 1970's, which threatened fossil fuel supplies and sent fossil fuel prices shooting upwards, the decline in fuelwood use would surely have continued. Instead, home heating costs soared and many shocked homeowners turned to wood energy as an economically viable alternative to fossil fuels, setting the stage for a resurgence in its use.

CONSUMPTION

In Michigan, the resurgence in residential fuelwood use resulted in one in three households taking advantage of wood energy (Michigan Department of Natural Resources 1982)[1], and sent the volume of fuelwood burned, i.e. consumption, skyrocketing to levels not seen in half a century (fig. 1). Since then, residential fuelwood use in Michigan has been sliding back to pre-energy crisis levels as stable fossil fuel supplies, steady, if not falling, fossil fuel prices, and disenchantment with the realities, i.e. work, of burning wood have turned households away from wood as a home heating fuel. After 10 years of attrition, only one in six Michigan households continues to burn wood, and each burns only about half as much volume as a household did in 1982 (tables 1, 2). Even fewer households plan to burn wood during the 1993 burning season; and with more than 90 percent of planned installations of wood-burning facilities being replacement units for households already engaged in wood burning, it is unlikely that first-time buyers/burners will compensate for these anticipated losses.

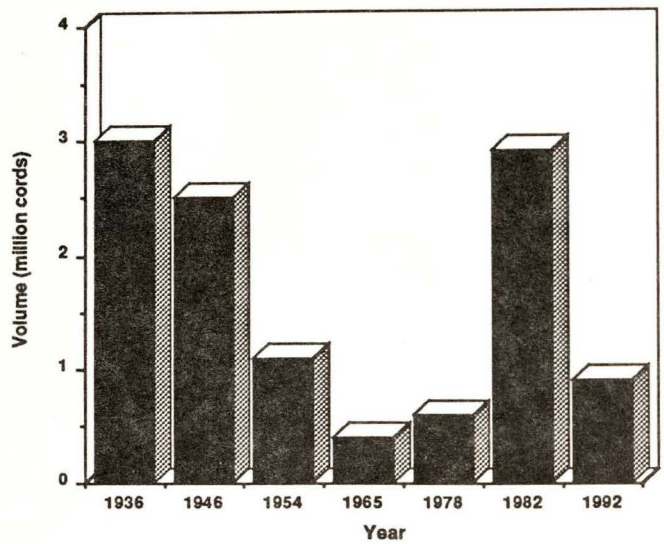

Figure 1.—*Residential fuelwood consumption, Michigan, 1936-1992.*

The lower rate of fuelwood use by Michigan's remaining wood-burning households reduced total residential fuelwood consumption to 869 thousand cords in 1992, only a third of that in

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[1] *Michigan Department of Natural Resources. 1982. Fuelwood use in Michigan homes: 1981-82 survey results. Lansing, MI: Michigan Department of Natural Resources, Forest Management Division. 24 p.*

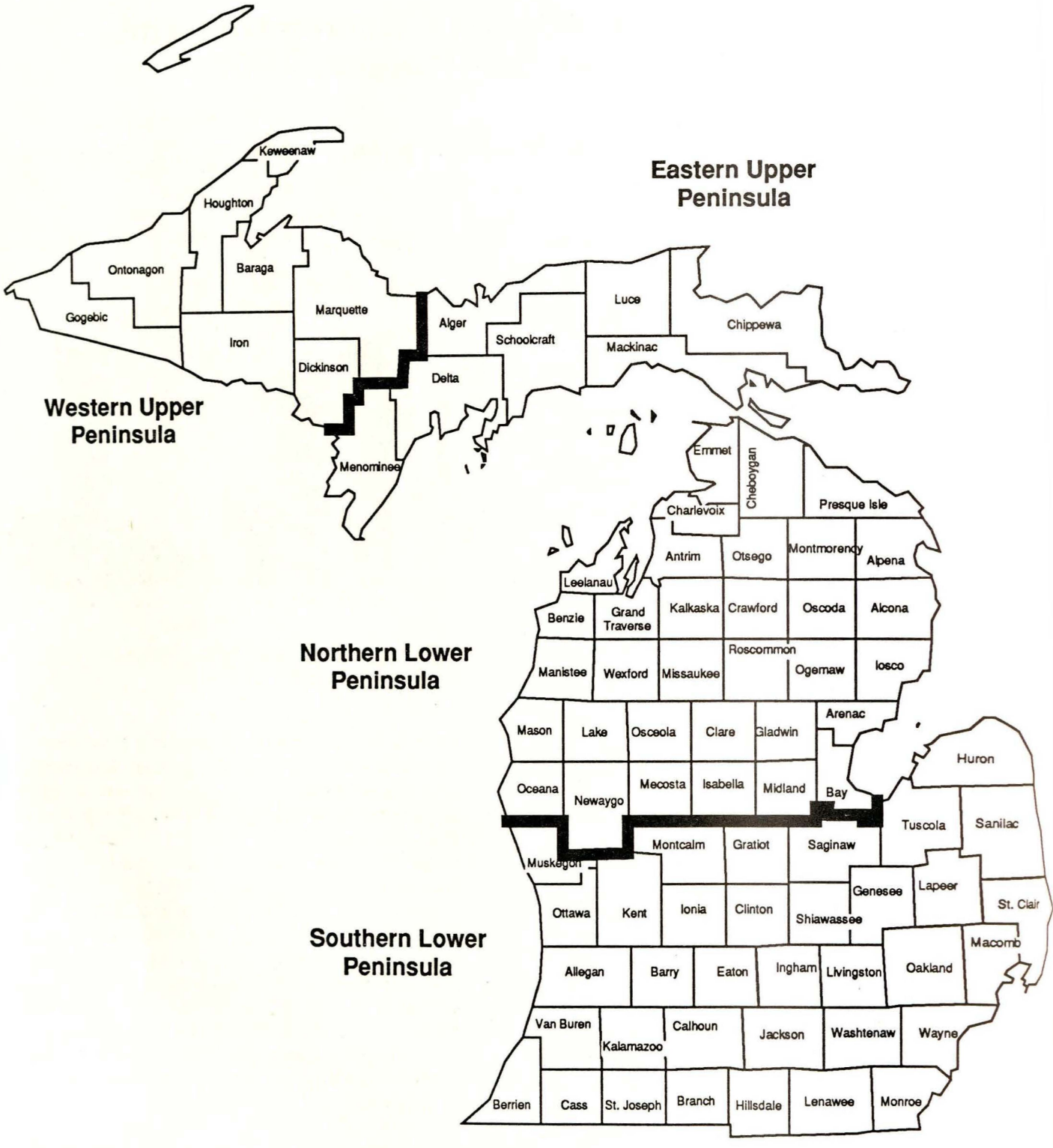

Figure 2.—*Forest Survey Units in Michigan.*

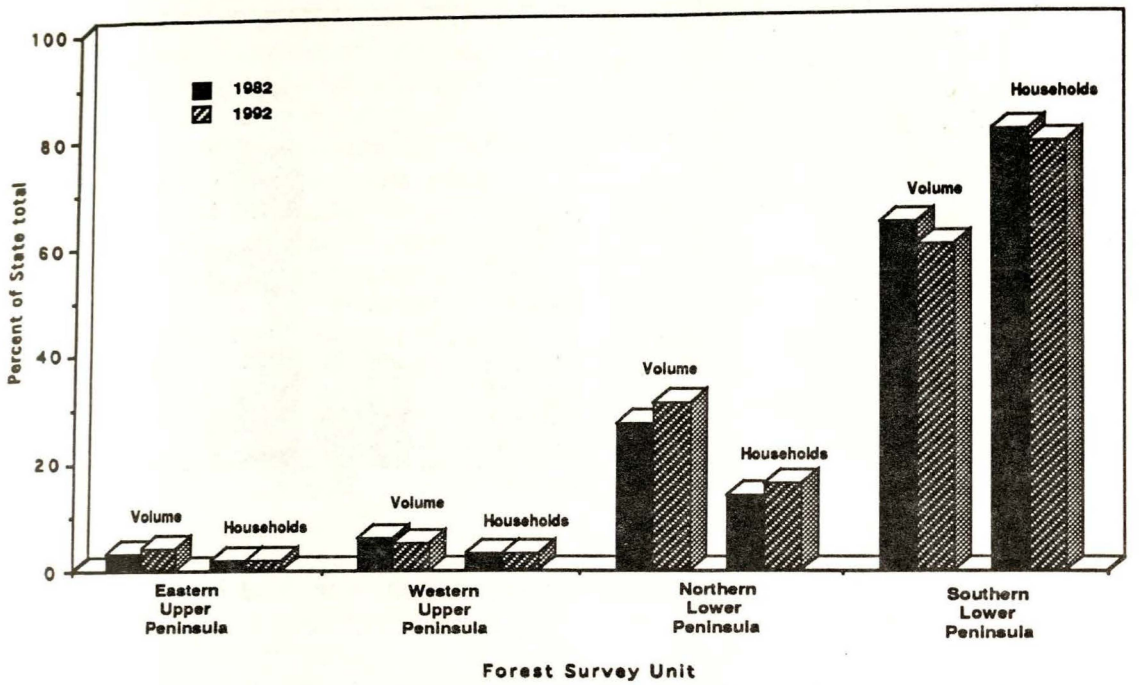

Figure 3.—*Distribution of residential fuelwood consumption by Forest Survey Unit, Michigan, 1982 and 1992.*

1982. Although the declines in households and consumption occurred across the State, the declines were more prevalent in the populous Southern Lower Peninsula (fig. 2), where most wood burners reside and most wood burning takes place (fig. 3). The higher rate of attrition among southern Survey Unit wood burners suggests that urban characteristics (income levels, infrastructure, fossil fuel price competition, wood availability, etc.) played a role in negating any perceived benefits associated with using wood fuel for many one-time urban wood burners. As a result, more of the State's residential fuelwood consumption is now taking place in the more rural northern Survey Units of the State, where wood fuel is far more popular. In these Units, not only do more households burn wood (one in four), but each household also consumes, on average, about three times as much fuelwood as its urban counterpart (tables 1, 2).

The reasons for burning wood also differ across the State. Although pleasure is the most popular reason for burning wood in Michigan residences, recreational burning is far more popular with the urban wood burners of the southern Survey Unit (table 2). In contrast, home heating, which consumes the most fuelwood, is the main reason for burning wood in the more northern Survey Units. This north/south disparity in motivation for the burning of wood provides further evidence of rural/urban influences on the substitution value of wood as a residential heating source, and accounts for much of the regional difference in average fuelwood consumption rates. Since the resurgence in residential fuelwood use, recreational burning in the Upper Peninsula and wood burning for primary home heating in the Lower Peninsula have fallen from favor, furthering the north/south disparity. In total though, there has been a movement away from primary home heating by the State's remaining wood burners, which has contributed to the decline in fuelwood consumption in the last 10 years (fig. 4).

The north/south, urban/rural differences in Michigan's wood burners are also evident in the types of wood-burning facilities in use. Although the most numerous of all wood-burning facilities in the State, fireplaces are most popular with the recreational wood burners of the southern Survey Unit (tables 3, 4). In contrast, wood stoves and furnaces are preferred in the more northern Units where home heating still prevails, as reflected by the higher average consumption rates for these Units and facilities. Since 1982, the popularity and use of wood stoves and fireplaces have increased at the expense of wood furnaces and fireplace inserts (fig. 5), which is in line with the move away from primary heating with wood in the State and the rise in recreational burning in the urban southern Survey Unit. While the average

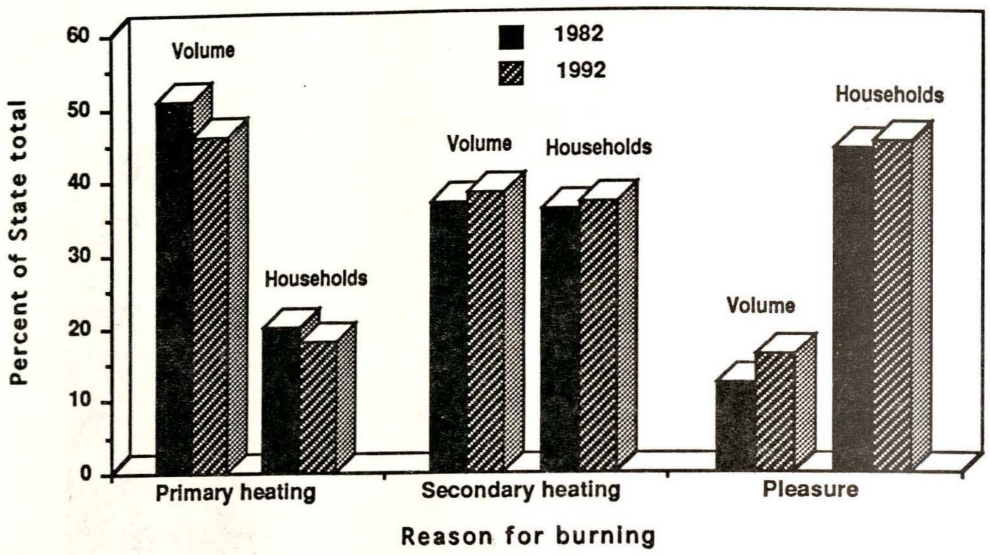

Figure 4.—*Distribution of residential fuelwood consumption by reason for burning, Michigan, 1982 and 1992.*

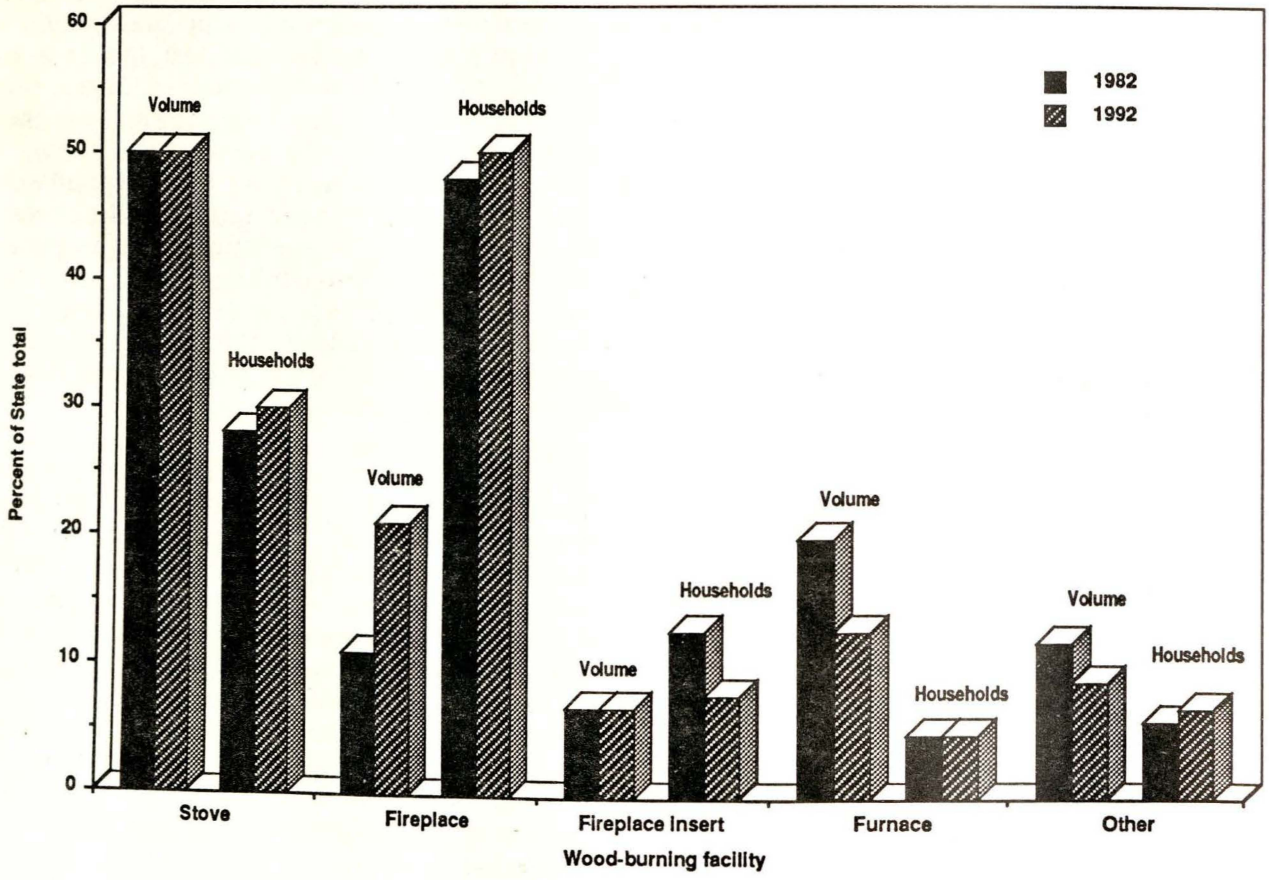

Figure 5.—*Distribution of residential fuelwood consumption by wood-burning facility, Michigan, 1982 and 1992.*

consumption of fuelwood by the more popular fireplaces has remained about the same as in 1982, the average consumption of fuelwood by wood stoves and furnaces has fallen by half in the same time period. These declines support the trend away from primary heating for which these two facilities are often used; and when examined in combination with the 50-percent decline in average fuelwood consumption by households still engaged in home heating, they suggest that improvements in both wood stove and furnace combustion efficiencies and home insulation have taken place since the oil crisis first raised the need for energy conservation.

Due to limited ownership and short-term occupancies, only a small portion of the State's residential fuelwood is consumed in secondary residences (table 5). Of the volume burned, most is consumed in the Northern Lower Peninsula by residents of the Southern Lower Peninsula. In fact, most of the residents of the southern Survey Unit that burn wood in secondary homes do so in the more rural northern Units, providing interesting insights into their vacation-destination preferences during urban escapes.

Two-thirds of today's wood burners are long-time veterans, having first burned wood more than 5 years ago (table 6). They are more likely to burn wood in stoves and furnaces for home heating purposes, and consequently burn an even higher proportion of the total fuelwood consumed. They also comprise two-thirds of the market for installations of new wood-burning facilities. Given their past investments in, and continuing commitment to, wood burning in light of the mass exodus from wood burning in the last 10 years, it is evident that these veteran wood burners form the core of Michigan's residential fuelwood market. Two-fifths burn wood mainly for pleasure, suggesting that many derive something other than just economic benefits from the gathering, splitting, stacking, stoking, and cleaning associated with wood burning.

Michigan's wood-burning households consume mainly roundwood, but wood residues do supply about 1 in 10 households with all or part of their fuelwood needs, equivalent to 5 percent of all fuelwood consumed (table 7). The State's wood burners realize the benefits of burning denser hardwoods, with softwood use limited to about 3 percent of the volume and households (table 8). Oak and maple are the hardwood species most commonly burned; maple is preferred in the Upper Peninsula and oak is the species of choice in the Lower Peninsula.

Half of Michigan's wood-burning households purchased all or part of the fuelwood they consumed during the 1992 heating season (table 9). Purchased wood was most commonly delivered in face cords, but 8-foot wood was also popular, especially in the more rural Survey Units of the State (table 10). Wood-burning residents in the northern portion of the State purchase a larger portion of their fuelwood needs than do their counterparts in the urban south, a possible reflection of the higher fuelwood requirements needed for home heating. In total, two-fifths of the residential fuelwood consumed in 1992 was purchased; the remainder was supplied by members of wood-burning households that cut their own wood.

PRODUCTION

To supply existing and future residential fuelwood consumption needs, members of Michigan's wood-burning households produced (i.e. harvested) more than 580 thousand cords of roundwood fuelwood in 1992, and commercial producers harvested another 36 thousand cords for resale (table 11). Because of seasoning time, leftover fuelwood inventories from previous years, and gift or free wood, consumption and production volumes can differ. However, the large difference between the volume purchased and burned during the 1992 heating season and the volume harvested by commercial producers in the same period does suggest that much of the market for residential fuelwood is being met by "underground" suppliers, i.e. individuals who have the necessary equipment and access to timber to take advantage of the economic opportunities created by Michigan's wood-purchasing wood burners, but who do not necessarily meet the State's classification of a commercial producer. At the same time, the similarity between the consumption and production volumes of self-cut fuelwood does add credence to the results.

Essentially all of the fuelwood produced by Michigan's fuelwood gatherers was harvested within the State, with most harvested from the Southern Lower Peninsula (table 12). Private lands and two preferred species of trees (oaks and maples) supplied most of the fuelwood harvest (tables 13, 14, 15, 16). Despite being regionally concentrated and species specific, the impacts of fuelwood harvesting on the State's forests have been declining in recent years. Since the last survey of residential fuelwood production in 1986 (Smith and Weatherspoon

1990)[2], fuelwood production has fallen by 60 percent, fuelwood production from non-woodland sources has climbed to 40 percent of the total, and a larger portion of the fuelwood harvests from woodland sources is coming from dead trees (fig. 6). This reduced impact is especially evident in the Southern Lower Peninsula, where most of the fuelwood production is harvested from non-woodland sources. Pressure on woodlands and live trees within woodlands does, however, increase in the more rural northern Survey Units, and most of the fuelwood harvested by commercial producers is also taken from these two sources. Statewide though, only 12 percent of all fuelwood produced is removed from growing-stock portions of live woodland (timberland) trees (tables 17, 18), half as much as in 1982 (fig. 7). Therefore, on the whole, the impact of residential fuelwood production on the traditional supply sources of the State's primary forest products industry is relatively small and diminishing as residential fuelwood use declines in popularity.

CONCLUSIONS

Today, not only are fewer Michigan households burning wood, but those that continue to do so are also burning less, bringing consumption and production down to 869 and 620 thousand cords, respectively. Much of the decline in residential fuelwood use can be tied to the perceived decline in economic benefits associated with using wood as a substitute for fossil-based home heating fuels as households have adjusted to current prices for fossil-based home heating fuel. This loss of economic incentive has been

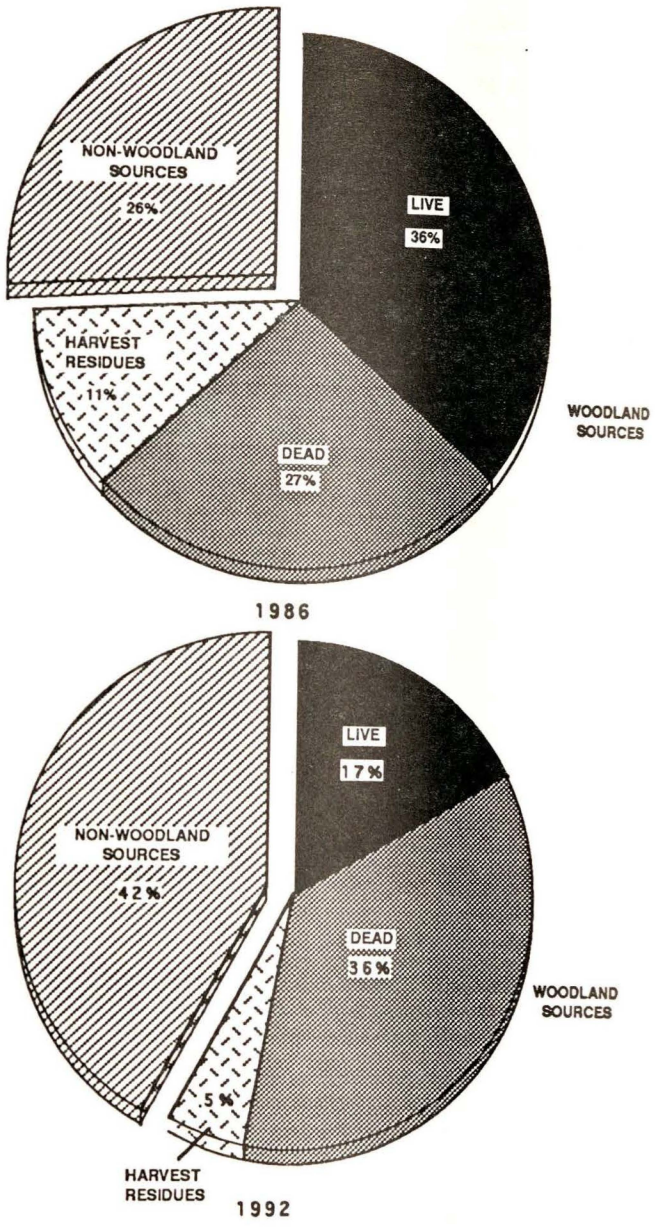

Figure 6.—*Residential fuelwood production in Michigan by source of material, 1986 and 1992.*

[2] *Smith, W. Brad; Weatherspoon, Anthony. 1990. Production and sources of residential fuelwood from roundwood in Michigan, 1986. Resour. Bull. NC-122. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 76 p.*

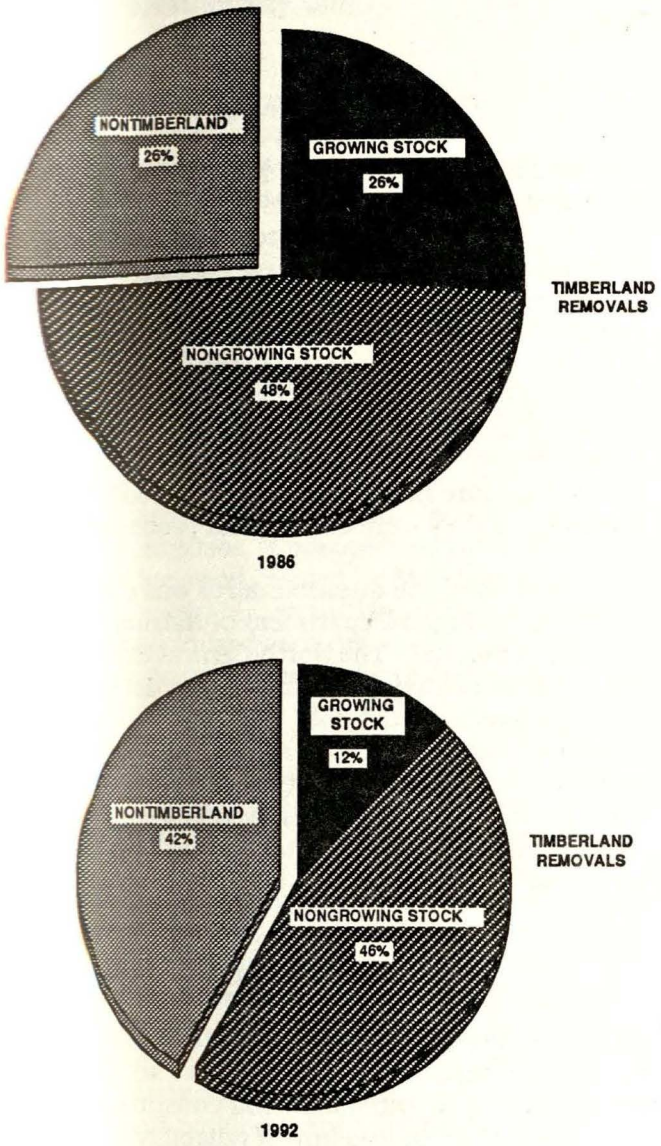

Figure 7.—*Distribution of timber removals associated with residential fuelwood production in Michigan, 1986 and 1992.*

more pronounced among the more urban wood burners, resulting in regional disparities in residential fuelwood use that divide along north/south, urban/rural lines within the State. In light of declining economic incentives to burn wood, the shift to recreational burning is testimony to the aesthetic appeal that wood fires have among the remaining wood-burning households in the State. Many of these remaining wood burners are seasoned veterans that form the backbone of the State's residential fuelwood market. Barring a surge in fossil fuel prices that would once again entice people back into wood burning, it is likely that residential fuelwood use will continue to be focused on this core group of devoted wood burners. As it has in the recent past, technology may also play a role in determining the future of fuelwood consumption in Michigan. With the popularity of recreational burning in fireplaces, the new generation of gas fireplaces, which offer many of the aesthetic pleasures without many of the inconveniences associated with wood fires, may well replace some of the wood volume being burned for pleasure. This may be especially true in urban areas serviced by natural gas. On the other hand, the convenience of the new generation of wood stoves and furnaces that burn pelletized wood fuels may encourage new use or bring back former burners that tired of the work involved in burning wood. Without doubt, future residential fuelwood use and the resulting impacts on the forests and economies of the State will fluctuate in response to changes in fossil fuel prices, technological advances, and homeowner attitudes and socio-economic status, as in the past.

APPENDIX

STUDY METHODS

Data for this publication were collected by a telecommunications company contracted by the Michigan Department of Natural Resources to conduct a telephone survey during June and July of 1992. The telephone survey sampled Michigan households and canvassed all known commercial producers, using formal questionnaires prepared by the North Central Forest Experiment Station and approved by the Federal Office of Management and Budget.

Households

The sampled universe encompassed all households in Michigan with telephones. A total sample size of 5,123 households was selected based on funding available and a desired standard error of less than ± 10 percent statewide at one standard deviation. Michigan was divided into survey units: (1) the Eastern Upper Peninsula, containing 48,863 households; (2) the Western Upper Peninsula, containing 69,827 households; (3) the Northern Lower Peninsula, containing 328,710 households; and (4) the Southern Lower Peninsula, containing 2,971,931 households. The sample was apportioned to each survey unit and each county within a survey unit based on county population and occupied households data from the 1990 census. A random list of telephone numbers was generated for each county using all listed three-digit phone exchanges. The number of samples to be taken in each county was evenly distributed across the phone exchanges in each county. One call was placed (whether successful or unsuccessful) to each of the random telephone numbers until the necessary number of residential households within each exchange and county was contacted. In both the Eastern and Western Upper Peninsula Survey Units about 1 in 200 households were sampled, about 1 in 400 hundred households were sampled in the Northern Lower Peninsula Survey Unit, and about 1 in 800 households were sampled in the Southern Lower Peninsula Survey Unit. These sampling rates were used to expand sample responses of fuelwood use to Unit-level estimates of total fuelwood use.

Commercial Producers

The Michigan Department of Natural Resources identified 315 commercial producers of fuelwood from its "Directory of wood producers, truckers, brokers, and dealers." All these commercial producers were canvassed by the telecommunications firm about their production of residential fuelwood, using a formal questionnaire similar to that used for households. Possible duplicate sampling of commercial producers was minimized by questioning all sample households producing more than 20 cords of fuelwood to determine if they were commercial producers.

Initial editing of the questionnaires was completed by Michigan Department of Natural Resources personnel. The North Central Station did the final editing and compiled the data. Some respondents did not know the species cut or burned for fuel, except in general terms such as mixed hardwoods. To facilitate reporting for each Survey Unit, mixed hardwoods were prorated to each of the hardwood species specifically identified as being harvested or burned in that Unit.

SAMPLING ERROR

All the reported figures are estimates based on sampling procedures designed to give accurate estimates of residential fuelwood consumption and production. A measure of reliability of these figures is given by sampling errors. This sampling error means that the chances are two out of three that the results for the sample differ by no more than the amount indicated from the results that would have been obtained if a complete census of all households and commercial producers had been made. Sampling errors for estimates of residential fuelwood consumption and production in Michigan are shown on the next page:

Forest Survey Unit	Consumption (Cords)	Error (Percent)	Production (Cords)	Error (Percent)
Eastern Upper Peninsula	36,309	19.1	20,799	26.6
Western Upper Peninsula	47,115	13.6	32,777	38.5
Northern Lower Peninsula	268,192	9.8	170,091	13.3
Southern Lower Peninsula	518,187	7.5	395,948	11.1
All Units	869,803	5.5	619,616	7.9

STUDY LIMITATIONS

This study reports both the consumption and production of residential fuelwood in Michigan for a 1-year period ending at the time of the telephone survey, essentially encompassing the 1991/92 burning season, but dated 1992 for reporting purposes. Consumption refers to the volume of fuelwood burned by Michigan's wood-burning households, regardless of the source of the fuelwood (roundwood, wood residues from primary or secondary manufacturing, scrap or waste wood products, etc.). Production, on the other hand, refers **only** to the volume of roundwood harvested to supply Michigan's wood-burning households. Production **does not** include fuelwood produced from wood residues generated at primary wood-using mills (such as sawmills and cooperage mills), fuelwood produced from roundwood for industrial consumption, fuelwood produced from wood residues generated at secondary wood-using mills (such as millwork plants and furniture plants), or fuelwood produced from waste wood products. However, fuelwood produced from primary mill residues and fuelwood produced for industrial consumption are captured in other studies. And although fuelwood production from secondary mill residues and waste secondary wood products is beyond the scope of Forest Inventory and Analysis duties, part of this volume is captured in the consumption portion of the residential fuelwood studies.

Households without telephones were not sampled. Study results may be slightly biased if the fuelwood consumption or production per household is significantly different in quantity or sources between phoneless households and households with phones. To compensate for this omission, sample responses from households with phones were assumed representative of the relatively small number of households without phones, and were expanded across all existing households in Michigan.

The canvass of commercial fuelwood producers was limited to those individuals or companies listed in the Michigan Department of Natural Resources' "Directory of wood producers, truckers, brokers, and dealers." Any individual or company producing fuelwood for the residential market and not listed was missed, and without adequate information on total numbers could not be accounted for by statistical expansion.

DEFINITION OF TERMS

Commercial producers.—Commercial fuelwood operators. Those who harvest fuelwood to sell to dealers or consumers. Includes loggers who harvest fuelwood along with saw logs and other products.

Cord.—See Standard cord.

Face cord.—A stack of stove length wood (most commonly 16 inches wide) that is 4 feet high and 8 feet long.

Fuelwood consumption.—The fuelwood burned by residential households.

Fuelwood production.—The volume of roundwood harvested to supply residential households.

Growing-stock (volume).—Net volume in cubic feet of growing-stock trees 5.0 inches d.b.h. and over, from a 1-foot stump to a minimum 4.0-inch top diameter outside bark of the central stem.

Harvest residues.—The unused portions of trees cut or killed by logging.

Nonforest land.—Land that has never supported forests, and land formerly forested where use for timber management is precluded by development for other uses. Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and

adjoining clearings, power line clearings of any width, and 1- to 40-acre areas of water classified by the Bureau of the Census as land.

Nontimberland.—See Nonforest land.

Non-woodland.—See Nontimberland.

Primary wood-using mills.—Mills receiving roundwood or chips from roundwood for processing into primary products (lumber, plywood, etc.).

Roundwood.—Logs and bolts from harvested trees including chips produced directly from harvested trees.

Secondary wood-using mills.—Mills receiving primary wood products for manufacture into secondary wood products (furniture, cabinets, etc.).

Standard cord.—A pile of logs 4x4x8 feet (128 cubic feet including air space and bark). A standard cord of fuelwood contains 70 cubic feet of wood and 58 cubic feet of bark and air space.

Timberland.—Forest land producing or capable of producing crops of industrial wood and not withdrawn from timber utilization. Areas qualifying as timberland have the capability of producing in excess of 20 cubic feet per acre per year of annual growth under management. Currently inaccessible and inoperable areas are included, except when the areas involved are small and unlikely to become suitable for production of industrial wood in the foreseeable future. In this paper, woodland was assumed to be timberland.

Wood residues.—Includes woody material (bark, coarse, fine, etc.) generated at primary wood-using mills, woody material (sawdust, scrap, trim, wood flour, etc.) generated at secondary wood-using plants, and waste secondary wood products.

Woodland.—See Timberland.

COMMON AND SCIENTIC NAMES OF TREE SPECIES MENTIONED IN THIS REPORT

SOFTWOODS
- Northern white-cedar ..... *Thuja occidentalis*
- Balsam fir ..... *Abies balsamea*
- Spruce
  - White spruce ..... *Picea glauca*
  - Black spruce ..... *Picea mariana*
- Pine
  - White pine ..... *Pinus strobus*
  - Red pine ..... *Pinus resinosa*
  - Jack pine ..... *Pinus banksiana*

HARDWOODS
- Ash
  - Black ash ..... *Fraxinus nigra*
  - White ash ..... *Fraxinus americana*
  - Green ash ..... *Fraxinus pennsylvanica*
- Aspen
  - Bigtooth aspen ..... *Populus grandidentata*
  - Quaking aspen ..... *Populus tremuloides*
  - Balsam poplar ..... *Populus balsamifera*
- Basswood ..... *Tilia americana*
- Beech ..... *Fagus grandifolia*
- Birch
  - Paper birch ..... *Betula papyrifera*
  - Yellow birch ..... *Betula alleghaniensis*
- Boxelder ..... *Acer negundo*
- Black cherry ..... *Prunus serotina*
- Cottonwood ..... *Populus deltoides*
- Elm
  - American elm ..... *Ulmus americana*
  - Rock elm ..... *Ulmus thomasii*
  - Slippery elm ..... *Ulmus rubra*
- Hickory
  - Shagbark hickory ..... *Carya ovata*
  - Shellbark hickory ..... *Carya laciniosa*
  - Mockernut hickory ..... *Carya tomentosa*
  - Pignut hickory ..... *Carya glabra*
  - Bitternut hickory ..... *Carya cordiformis*
- Locust
  - Black locust ..... *Robinia pseudoacacia*
  - Honeylocust ..... *Gleditsia triacanthos*
- Maple
  - Hard maple
    - Sugar maple ..... *Acer saccharum*
    - Black maple ..... *Acer nigrum*
  - Soft maple
    - Red maple ..... *Acer rubrum*
    - Silver maple ..... *Acer saccharinum*
- Mulberry ..... *Morus rubra*
- Oak
  - Red oak
    - Northern red oak ..... *Quercus rubra*
    - Black oak ..... *Quercus velutina*
    - Scarlet oak ..... *Quercus coccinea*
    - Pin oak ..... *Quercus palustris*
    - Northern pin oak ..... *Quercus ellipsoidalis*
  - White oak
    - White oak ..... *Quercus alba*
    - Bur oak ..... *Quercus macrocarpa*
    - Swamp white oak ..... *Quercus bicolor*

Chinkapin oak ..... *Quercus muehlenbergii*
Chestnut oak ..... *Quercus rubra*
Sassafras ..... *Sassafras albidum*
Black walnut ..... *Juglans nigra*
Willow ..... *Salix* spp.
Noncommercial species
Alder ..... *Alder* spp.
Apple ..... *Malus* spp.
Cherry ..... *Prunus* spp.
Ironwood ..... *Ostrya virginiana*
Viburnum ..... *Viburnum* spp.

TABLE TITLES

Table 1.—Possession and use of wood-burning facilities by Forest Survey Unit, Michigan, 1992

Table 2.—Residential fuelwood consumption by reason for burning and Forest Survey Unit, Michigan, 1992

Table 3.—Residential fuelwood consumption by type of wood-burning facility and Forest Survey Unit, Michigan, 1992

Table 4.—Residential fuelwood consumption by type of wood-burning facility and reason for burning, Michigan, 1992

Table 5.—Fuelwood consumption in secondary residences within each Forest Survey Unit by wood burners of each Unit, Michigan, 1992

Table 6.—Residential fuelwood consumption by reason for burning and burning tenure, Michigan, 1992

Table 7.—Residential fuelwood consumption by type of fuelwood, Michigan, 1992

Table 8.—Residential fuelwood consumption by species group and Forest Survey Unit, Michigan, 1992

Table 9.—Residential fuelwood consumption by method of procurement and Forest Survey Unit, Michigan, 1992

Table 10.—Size of fuelwood purchased for residential consumption in Michigan, 1992

Table 11.—Residential fuelwood production by type of producer and source of material, Michigan, 1992

Table 12.—Residential fuelwood production by State, Forest Survey Unit, and source of material, Michigan, 1992

Table 13.—Residential fuelwood production from roundwood by ownership class and Forest Survey Unit, Michigan, 1992

Table 14.—Residential fuelwood production from roundwood by species group and ownership class, Michigan, 1992

Table 15.—Residential fuelwood production from roundwood by species group and source of material, Michigan, 1992

Table 16.—Residential fuelwood production from roundwood by species group and Forest Survey Unit, Michigan, 1992

Table 17.—Distribution of timber removals associated with residential fuelwood production by Forest Survey Unit, Michigan, 1992

Table 18.—Distribution of timber removals associated with residential fuelwood production by species group, Michigan, 1992

Table 1.--Possession and use of wood-burning facilities by Forest Survey Unit, Michigan, 1992

Forest Survey Unit	Households	Households with wood-burning facilities	Households burning wood in 1992	Households planning to burn wood in 1993	Households planning to install wood-burning facilities
			(In number of households)		
Eastern Upper Peninsula	48,863	11,428	11,227	10,626	602
Western Upper Peninsula	69,827	17,443	17,443	16,240	1,002
Northern Lower Peninsula	328,710	92,023	90,817	88,406	9,644
Southern Lower Peninsula	2,971,931	458,636	458,636	445,029	21,611
Total	3,419,331	579,529	578,123	560,301	32,859

Table 2.--Residential fuelwood consumption by reason for burning and Forest Survey Unit, Michigan, 1992

Forest Survey Unit	Reason for burning	Households (Number)	Volume (Cords)	Average (Cords/household)
Eastern Upper Peninsula	Primary heat	5,814	26,806	4.61
	Secondary heat	3,408	7,859	2.31
	Pleasure	2,005	1,644	0.82
	All reasons	11,227	36,309	3.23
Western Upper Peninsula	Primary heat	7,218	29,873	4.14
	Secondary heat	7,418	15,718	2.12
	Pleasure	2,807	1,524	0.54
	All reasons	17,443	47,115	2.70
Northern Lower Peninsula	Primary heat	32,148	168,896	5.25
	Secondary heat	35,764	80,329	2.25
	Pleasure	22,905	18,967	0.83
	All reasons	90,817	268,192	2.95
Southern Lower Peninsula	Primary heat	58,430	171,848	2.94
	Secondary heat	167,286	224,275	1.34
	Pleasure	232,920	122,063	0.52
	All reasons	458,636	518,187	1.13
ALL UNITS	Primary heat	103,610	397,423	3.84
	Secondary heat	213,877	328,182	1.53
	Pleasure	260,637	144,198	0.55
	All reasons	578,123	869,803	1.50

Table 3.--Residential fuelwood consumption by type of wood-burning facility and Forest Survey Unit, Michigan, 1992

Forest Survey Unit	Wood-burning facility	Households (Number)	Volume (Cords)	Average (Cords/household)
Eastern Upper Peninsula	Stove	4,210	14,736	3.50
	Fireplace	2,807	3,549	1.26
	Fireplace insert	1,002	3,268	3.26
	Furnace	2,606	13,954	5.35
	Combinations	601	802	1.33
	All facilities	11,227	36,309	3.23
Western Upper Peninsula	Stove	8,421	21,272	2.53
	Fireplace	2,807	5,734	2.04
	Fireplace insert	601	2,867	4.77
	Furnace	3,208	11,247	3.51
	Fire pit	200	60	0.30
	Combinations	2,205	5,935	2.69
	All facilities	17,443	47,115	2.70
Northern Lower Peninsula	Stove	43,399	167,248	3.85
	Fireplace	24,513	22,704	0.93
	Fireplace insert	7,233	8,680	1.20
	Furnace	9,242	43,158	4.67
	Fire pit	1,206	121	0.10
	Combinations	5,224	26,281	5.03
	All facilities	90,817	268,192	2.95
Southern Lower Peninsula	Stove	115,259	227,797	1.98
	Fireplace	260,934	146,956	0.56
	Fireplace insert	36,019	48,665	1.35
	Furnace	16,008	46,584	2.91
	Fire pit	12,006	4,722	0.39
	Combinations	18,409	43,462	2.36
	All facilities	458,636	518,187	1.13
ALL UNITS	Stove	171,290	431,054	2.52
	Fireplace	291,061	178,943	0.61
	Fireplace insert	44,856	63,480	1.42
	Furnace	31,065	114,944	3.70
	Fire pit	13,412	4,903	0.37
	Combinations	26,440	76,480	2.89
	All facilities	578,123	869,803	1.50

Table 4.--Residential fuelwood consumption by type of wood-burning facility and reason for burning, Michigan, 1992

Type of facility	Primary heat		Secondary heat		Pleasure		All reasons	
	Households (Number)	Volume (Cords)	Households (Number)	Volume (Cords)	Households (Number)	Volume (Cords)	Households (Number)	Volume (Cords)
Stove	68,545	253,367	85,519	166,826	17,225	10,860	171,290	431,054
Fireplace	6,807	11,796	69,468	53,927	214,786	113,220	291,061	178,943
Fireplace insert	3,407	14,167	31,640	42,047	9,809	7,265	44,856	63,480
Furnace	14,834	82,000	15,628	31,719	602	1,226	31,065	114,944
Fire pit	800	720	--	--	12,612	4,183	13,412	4,903
Combinations	9,216	35,373	11,621	33,663	5,603	7,444	26,440	76,480
All facilities	103,610	397,423	213,877	328,182	260,637	144,198	578,123	869,803

Table 5.--Fuelwood consumption in secondary residences within each Forest Survey Unit by wood burners of each Unit, Michigan, 1992

Primary residence of wood burners	Location of secondary residence: Eastern Upper Peninsula		Western Upper Peninsula		Northern Lower Peninsula		Southern Lower Peninsula		Total consumption by wood burners of each unit	
	Households (Number)	Volume (Cords)	Households (Number)	Volume (Cords)	Households (Number)	Volume (Cords)	Households (Number)	Volume (Cords)	Households (Number)	Volume (Cords)
Eastern Upper Peninsula	802	1,023	--	--	--	--	200	60	1,002	1,083
Western Upper Peninsula	200	60	1,203	2,045	--	--	200	341	1,603	2,446
Northern Lower Peninsula	--	--	402	804	8,037	10,689	804	442	9,243	11,935
Southern Lower Peninsula	800	560	800	2,161	16,008	12,166	6,403	15,848	24,011	30,735
Total consumption within each Unit	1,802	1,643	2,405	5,010	24,045	22,855	7,607	16,691	35,859	46,199

Table 6.--Residential fuelwood consumption by reason for burning and burning tenure, Michigan, 1992

Reason for burning	Started burning wood	Households (Number)	Volume (Cords)	Average (Cords/household)
Primary heat	Last year	5,409	23,098	4.27
	2 years ago	9,017	12,429	1.38
	3 years ago	5,813	31,603	5.44
	4-5 years ago	4,409	17,152	3.89
	More than 5 years ago	78,962	313,140	3.97
	All times	103,610	397,423	3.84
Secondary heat	Last year	18,827	23,224	1.23
	2 years ago	20,221	22,969	1.14
	3 years ago	16,614	15,897	0.96
	4-5 years ago	15,015	20,223	1.35
	More than 5 years ago	143,199	245,869	1.72
	All times	213,877	328,182	1.53
Pleasure	Last year	38,836	20,597	0.53
	2 years ago	19,018	14,126	0.74
	3 years ago	17,818	8,529	0.48
	4-5 years ago	21,423	9,589	0.45
	More than 5 years ago	163,543	91,356	0.56
	All times	260,637	144,198	0.55
All reasons	Last year	63,072	66,919	1.06
	2 years ago	48,256	49,524	1.03
	3 years ago	40,245	56,029	1.39
	4-5 years ago	40,847	46,965	1.15
	More than 5 years ago	385,704	650,365	1.69
	All times	578,123	869,803	1.50

Table 7.--Residential fuelwood consumption by type of fuelwood, Michigan, 1992

Fuelwood type	Households (Number)	Roundwood (Cords)	Wood residues (Cords)	Average (Cords/household)
Roundwood	524,066	761,024	--	1.45
Wood residues	6,406	--	6,052	0.94
Both types	47,651	67,799	34,928	2.16
All types	578,123	828,823	40,980	1.50

Table 8.--Residential fuelwood consumption by species group and Forest Survey Unit, Michigan, 1992

Species group	All Units	Eastern Upper Peninsula	Western Upper Peninsula	Northern Lower Peninsula	Southern Lower Peninsula
			(In standard cords)		
SOFTWOODS					
Balsam fir	146	146	--	--	--
Cedar	11,382	659	--	1,025	9,699
Pine	14,396	674	--	5,027	8,695
Spruce	97	97	--	--	--
Total	26,021	1,576	--	6,052	18,393
HARDWOODS					
Alder	455	--	--	17	438
Apple	10,655	--	--	92	10,563
Ash	49,008	706	--	22,898	25,404
Aspen	41,699	496	24	24,355	16,824
Basswood	526	--	3	443	79
Beech	17,455	3,971	2	2,384	11,098
Birch	12,336	3,161	1,919	3,501	3,755
Boxelder	2,654	--	1	--	2,653
Cherry	24,988	242	434	3,815	20,496
Cottonwood	7,175	245	--	776	6,154
Elm	58,679	884	5,189	12,086	40,521
Hickory	10,534	64	--	--	10,470
Ironwood	241	--	--	241	--
Locust	5,890	--	--	1,176	4,714
Maple	229,954	23,636	32,371	70,293	103,654
Mulberry	292	--	--	--	292
Oak	368,427	1,329	7,171	119,946	239,981
Walnut	2,639	--	--	116	2,523
Willow	175	--	--	--	175
Total	843,782	34,733	47,115	262,140	499,793
ALL SPECIES	869,803	36,309	47,115	268,192	518,187

Table 9.--Residential fuelwood consumption by method of procurement and Forest Survey Unit, Michigan, 1992

Forest Survey Unit	Procurement method	Households (Number)	Volume purchased (Cords)	Volume cut (Cords)	Average (Cords/household)
Eastern Upper Peninsula	Buy	5,012	17,944	--	3.58
	Cut	5,213	--	10,927	2.10
	Buy and cut	1,002	2,579	4,859	7.42
	All methods	11,227	20,523	15,786	3.23
Western Upper Peninsula	Buy	9,223	23,076	--	2.50
	Cut	6,416	--	19,207	2.99
	Buy and cut	1,804	2,385	2,447	2.68
	All methods	17,443	25,461	21,654	2.70
Northern Lower Peninsula	Buy	40,586	113,803	--	2.80
	Cut	39,381	--	94,795	2.41
	Buy and cut	10,850	17,214	42,380	5.49
	All methods	90,817	131,017	137,175	2.95
Southern Lower Peninsula	Buy	178,492	152,799	--	0.86
	Cut	233,720	--	301,035	1.29
	Buy and cut	46,424	19,735	44,618	1.39
	All methods	458,636	172,534	345,653	1.13
ALL UNITS	Buy	233,313	307,622	--	1.32
	Cut	284,729	--	425,964	1.50
	Buy and cut	60,081	41,914	94,303	2.27
	All methods	578,123	349,536	520,267	1.50

Table 10.--Size of fuelwood purchased for residential consumption in Michigan, 1992

Forest Survey Unit	Size of wood purchased	Households (Number)	Volume (Cords)	Average (Cords/household)
Eastern Upper Peninsula	16 inch	2,406	5,894	2.45
	24 inch	401	2,145	5.35
	8 foot	2,005	7,200	3.59
	Tree length	601	2,606	4.34
	Random length residues	401	896	2.23
	Unknown	200	1,782	8.91
	All sizes	6,014	20,523	3.41
Western Upper Peninsula	16 inch	4,210	8,186	1.94
	24 inch	1,002	2,156	2.15
	4 foot	401	2,205	5.50
	6 foot	601	1,123	1.87
	8 foot	3,809	11,083	2.91
	Tree length	200	66	0.33
	Random length roundwood	200	401	2.01
	Random length residues	601	241	0.40
	All sizes	11,027	25,461	2.31
Northern Lower Peninsula	16 inch	34,961	87,422	2.50
	24 inch	8,037	24,104	3.00
	4 foot	804	1,326	1.65
	8 foot	5,626	9,450	1.68
	Tree length	1,206	7,671	6.36
	Random length roundwood	804	1,045	1.30
	All sizes	51,436	131,017	2.55
Southern Lower Peninsula	16 inch	159,282	107,158	0.67
	24 inch	28,014	23,086	0.82
	4 foot	3,202	3,042	0.95
	6 foot	3,202	3,922	1.22
	8 foot	8,805	17,109	1.94
	Tree length	2,401	4,162	1.73
	Random length roundwood	7,204	5,491	0.76
	Random length residues	2,401	4,064	1.69
	Unknown	10,405	4,500	0.43
	All sizes	224,916	172,534	0.77
ALL UNITS	16 inch	200,859	208,661	1.04
	24 inch	37,455	51,491	1.37
	4 foot	4,406	6,573	1.49
	6 foot	3,803	5,045	1.33
	8 foot	20,245	44,842	2.21
	Tree length	4,409	14,505	3.29
	Random length roundwood	8,208	6,937	0.85
	Random length residues	3,404	5,200	1.53
	Unknown	10,606	6,282	0.59
	All sizes	293,394	349,536	1.19

Table 11.--Residential fuelwood production by type of producer and source of material, Michigan, 1992

Type of producer	All sources	Cities and villages	Windbreaks, fencerows, rural yards	Pasture and cropland	Woodlands		
					Standing live trees	Harvest residues	Dead trees
	(In standard cords)						
Residential	583,859	94,720	144,362	19,686	82,922	24,890	217,279
Commercial	36,478	1,058	4	437	22,441	7,736	4,801
All producers	620,337	95,778	144,366	20,123	105,363	32,626	222,080

Table 12.--Residential fuelwood production by State, Forest Survey Unit, and source of material, Michigan, 1992

State	Forest Survey Unit	All sources	Cities and villages	Windbreaks, fencerows, rural yards	Pasture and cropland	Woodlands		
						Standing live trees	Harvest residues	Dead trees
				(In standard cords)				
Michigan	Eastern Upper Peninsula	20,799	3,208	--	--	9,986	778	6,827
	Western Upper Peninsula	32,777	4,546	563	12	12,721	8,253	6,682
	Northern Lower Peninsula	170,091	26,353	3,560	2,991	43,584	10,825	82,778
	Southern Lower Peninsula	395,948	61,670	140,243	16,400	39,073	12,770	125,792
	ALL UNITS	619,616	95,778	144,366	19,403	105,363	32,626	222,080
Indiana	Northern	720	--	--	720	--	--	--
	ALL STATES	620,337	95,778	144,366	20,123	105,363	32,626	222,080

Table 13.--Residential fuelwood production from roundwood by ownership class and Forest Survey Unit, Michigan, 1992

Ownership class	All Units	Eastern Upper Peninsula	Western Upper Peninsula	Northern Lower Peninsula	Southern Lower Peninsula
		(In standard cords)			
National forest	6,857	4,853	308	1,695	--
Other federal	3,089	--	50	3,039	--
State	37,690	3,289	769	22,784	10,848
County	7,077	67	50	2,318	4,643
Forest industry	1,665	120	94	1,451	--
Other private	560,564	12,470	31,505	138,001	378,587
Unknown	2,674	--	--	804	1,870
All owners	619,616	20,799	32,777	170,091	395,948

Table 14.--Residential fuelwood production from roundwood by species group and ownership class, Michigan, 1992

Species group	All ownerships	National forest	Other federal	State	County	Forest industry	Other private	Unknown
				(In standard cords)				
SOFTWOODS								
Balsam fir	45	--	--	--	--	--	45	--
Cedar	926	--	--	7	--	--	920	--
Pine	19,581	289	--	483	--	--	18,809	--
Total	20,553	289	--	490	--	--	19,774	--
HARDWOODS								
Alder	5,132	7	--	56	20	14	5,036	--
Apple	7,588	2	--	137	69	5	7,361	15
Ash	23,886	170	--	1,894	596	111	20,847	269
Aspen	30,661	51	--	622	203	45	29,708	33
Basswood	1,551	23	--	238	1	159	1,129	--
Beech	15,345	1,814	--	267	100	95	13,050	19
Birch	10,065	294	10	976	97	48	8,637	2
Boxelder	11,583	--	--	569	123	--	10,862	29
Cherry	21,025	152	--	1,594	630	11	18,596	43
Cottonwood	3,008	1	--	391	124	2	2,484	6
Elm	50,135	15	--	3,204	464	25	46,327	101
Hickory	4,551	--	--	92	48	--	4,400	11
Ironwood	18	1	--	1	--	--	16	--
Locust	18,829	--	--	379	200	--	18,203	47
Maple	154,506	2,767	345	7,965	1,333	746	140,581	769
Mulberry	810	--	--	16	8	--	783	2
Oak	234,784	1,271	2,734	18,694	3,005	404	207,360	1,316
Sassafras	272	--	--	5	3	--	262	1
Viburnum	96	--	--	2	1	--	93	--
Walnut	4,679	1	--	88	45	2	4,534	10
Willow	539	--	--	11	6	--	521	1
Total	599,064	6,568	3,089	37,200	7,077	1,665	540,790	2,674
ALL SPECIES	619,616	6,857	3,089	37,690	7,077	1,665	560,564	2,674

Table 15.--Residential fuelwood production from roundwood by species group and source of material, Michigan, 1992

Species group	All sources	Cities and villages	Windbreaks, fencerows, rural yards	Pasture and cropland	Woodlands		
					Standing live trees	Harvest residues	Dead trees
			(In standard cords)				
SOFTWOODS							
Balsam fir	45	--	--	--	--	--	45
Cedar	926	22	79	--	6	7	812
Pine	19,581	721	14,467	--	1,227	71	3,096
Total	20,553	743	14,546	--	1,232	79	3,953
HARDWOODS							
Alder	5,132	117	39	82	164	33	4,697
Apple	7,588	1,716	1,105	190	718	80	3,779
Ash	23,886	1,710	2,294	2,239	6,784	1,859	8,999
Aspen	30,661	8,535	4,186	626	6,560	317	10,437
Basswood	1,551	139	11	9	259	913	220
Beech	15,345	2,381	3,598	290	2,323	180	6,574
Birch	10,065	1,559	267	74	3,442	318	4,405
Boxelder	11,583	1,422	3,445	322	1,129	137	5,129
Cherry	21,025	4,695	3,711	534	3,122	661	8,303
Cottonwood	3,008	883	457	77	601	61	928
Elm	50,135	7,611	13,172	1,744	6,701	3,413	17,495
Hickory	4,551	1,744	850	126	142	54	1,635
Ironwood	18	--	--	--	11	1	7
Locust	18,829	1,531	11,482	523	1,355	222	3,716
Maple	154,506	22,791	28,215	4,243	36,948	14,349	47,960
Mulberry	810	75	145	22	287	9	271
Oak	234,784	36,854	55,399	8,155	33,411	9,878	91,087
Sassafras	272	22	51	8	8	3	180
Viburnum	96	8	65	3	3	1	16
Walnut	4,679	933	1,226	121	146	51	2,202
Willow	539	311	101	15	17	6	89
Total	599,064	95,035	129,820	19,403	104,131	32,547	218,127
ALL SPECIES	619,616	95,778	144,366	19,403	105,363	32,626	222,080

Table 16.--Residential fuelwood production from roundwood by species group and Forest Survey Unit, Michigan, 1992

Species group	All sources	Eastern Upper Peninsula	Western Upper Peninsula	Northern Lower Peninsula	Southern Lower Peninsula
			(In standard cords)		
SOFTWOODS					
Balsam fir	45	45	--	--	--
Cedar	926	167	--	253	506
Pine	19,581	1,524	289	1,225	16,543
Total	20,553	1,736	289	1,478	17,050
HARDWOODS					
Alder	5,132	--	--	5,132	--
Apple	7,588	--	--	1,743	5,845
Ash	23,886	69	--	12,239	11,578
Aspen	30,661	418	878	16,010	13,356
Basswood	1,551	163	--	1,333	54
Beech	15,345	2,841	--	4,795	7,709
Birch	10,065	3,784	2,040	3,326	916
Boxelder	11,583	--	--	--	11,583
Cherry	21,025	44	234	3,617	17,130
Cottonwood	3,008	--	--	583	2,424
Elm	50,135	36	1,601	8,044	40,454
Hickory	4,551	--	--	--	4,551
Ironwood	18	18	--	--	--
Locust	18,829	--	--	--	18,829
Maple	154,506	9,279	26,284	35,777	83,166
Mulberry	810	--	--	32	777
Oak	234,784	2,411	1,452	75,261	155,660
Sassafras	272	--	--	--	272
Viburnum	96	--	--	--	96
Walnut	4,679	--	--	720	3,960
Willow	539	--	--	--	539
Total	599,064	19,063	32,489	168,613	378,899
ALL SPECIES	619,616	20,799	32,777	170,091	395,948

Table 17.--Distribution of timber removals associated with residential fuelwood production by Forest Survey Unit, Michigan, 1992

Forest Survey Unit	Saw-timber	Pole-timber	Total growing-stock removals	Limbwood	Sapling	Cull trees	Dead trees	Total nongrowing stock removals	Total timberland removals	Non-timberland removals	Total removals
						(In thousand cubic feet)					
Eastern Upper Peninsula	209	246	455	261	2	34	479	777	1,232	225	1,456
Western Upper Peninsula	365	355	720	666	6	62	483	1,217	1,936	359	2,295
Northern Lower Peninsula	1,009	1,111	2,120	1,482	13	175	5,814	7,484	9,604	2,303	11,907
Southern Lower Peninsula	936	1,002	1,938	1,469	13	186	8,828	10,497	12,435	15,282	27,717
ALL UNITS	2,518	2,714	5,232	3,879	34	457	15,604	19,974	25,206	18,168	43,374

Table 18.--Distribution of timber removals associated with residential fuelwood production by species group, Michigan, 1992

Species group	Saw-timber	Pole-timber	Total growing-stock removals	Limbwood	Sapling	Cull trees	Dead trees	Total nongrowing stock removals	Total timberland removals	Non-timberland removals	Total removals
						(In thousand cubic feet)					
SOFTWOODS											
Balsam fir	--	--	--	--	--	--	3	3	3	--	3
Cedar	--	--	--	--	--	--	57	57	58	7	65
Pine	25	30	55	31	--	4	217	252	308	1,063	1,371
Total	26	30	56	31	--	4	277	313	368	1,070	1,439
HARDWOODS											
Alder	--	--	--	5	--	8	329	343	343	17	359
Apple	--	--	--	20	--	36	265	320	320	211	531
Ash	160	175	335	239	2	26	633	900	1,235	437	1,672
Aspen	135	161	295	163	1	21	731	917	1,212	934	2,146
Basswood	17	11	29	48	--	3	17	69	97	11	109
Beech	49	57	106	61	1	8	461	529	635	439	1,074
Birch	73	85	158	92	1	12	309	414	572	133	705
Boxelder	24	28	52	32	--	4	359	395	448	363	811
Cherry	71	79	150	101	1	11	582	696	846	626	1,472
Cottonwood	13	15	28	16	--	2	65	84	111	99	211
Elm	179	182	361	308	3	30	1,231	1,572	1,933	1,577	3,510
Hickory	4	4	7	6	--	1	115	121	128	190	319
Ironwood	--	--	--	--	--	1	--	1	1	--	1
Locust	30	34	64	41	--	5	261	306	371	948	1,318
Maple	929	976	1,905	1,494	13	153	3,383	5,043	6,948	3,867	10,816
Mulberry	6	7	13	7	--	1	19	27	40	17	57
Oak	798	865	1,663	1,209	11	130	6,394	7,743	9,407	7,029	16,435
Sassafras	--	--	--	--	--	--	13	13	13	6	19
Viburnum	--	--	--	--	--	--	1	1	1	5	7
Walnut	4	4	7	6	--	1	154	161	168	160	328
Willow	--	--	1	1	--	--	6	7	8	30	38
Total	2,493	2,683	5,176	3,848	34	452	15,328	19,661	24,838	17,098	41,936
ALL SPECIES	2,518	2,714	5,232	3,879	34	457	15,604	19,974	25,206	18,168	43,374

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May, Dennis M.; Weatherspoon, Anthony K.; Hackett, Ronald L. 1993. **Residential fuelwood consumption and production in Michigan, 1992**. Resour. Bull. NC-148. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 29 p.

Reports findings of the latest survey of residential fuelwood consumption and production in Michigan, and compares findings with earlier survey results. Topics examined include the geographic distribution of residential fuelwood consumption and production within the State, the species of trees used for residential fuelwood, the types of wood-burning facilities used, the reasons for burning fuelwood, and the land, ownership, and tree classes from which fuelwood is produced.

KEY WORDS: Fireplace, firewood, households, roundwood, wood stove.

Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.